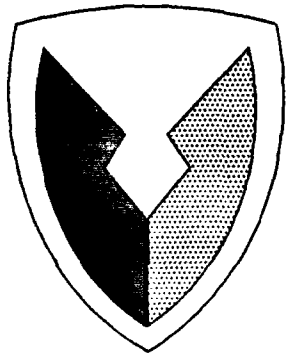
(2)



# VINTAGE STUDY





US ARMY
MATERIEL COMMAND

## INDUSTRIAL PLANT EQUIPMENT
## (IPE)

## 15 FEBUARY 1990



U.S. ARMY INDUSTRIAL ENGINEERING ACTIVITY
ROCK ISLAND, ILLINOIS
61299-7260

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This report is an analysis of the inventory of Army-owned Industrial Plant Equipment (IPE). The purpose of this study is to examine the trends and distribution of IPE within various categories, especially age. It covers inventory trends, historical background, condition code, equipment ownership, equipment type and status, and manufacturing origin.

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DEPARTMENT OF THE ARMY
US ARMY INDUSTRIAL ENGINEERING ACTIVITY
ROCK ISLAND, ILLINOIS 61299-7260

REPLY TO
ATTENTION OF

AMXIB (700-90a)

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: 1990 Vintage Study of Department of the Army Industrial Plant Equipment (IPE)

1. The enclosed study provides an overview of Department of the Army IPE. It examines the trends and distribution of IPE within various categories, with emphasis on the vintage (age profile) of the equipment. The study includes:

a. Status of the inventory within the Army.

b. Comparison with industry based on the age profile.

c. Status of the inventory within AMC.

d. Inventory of Numerical Control (NC) equipment.

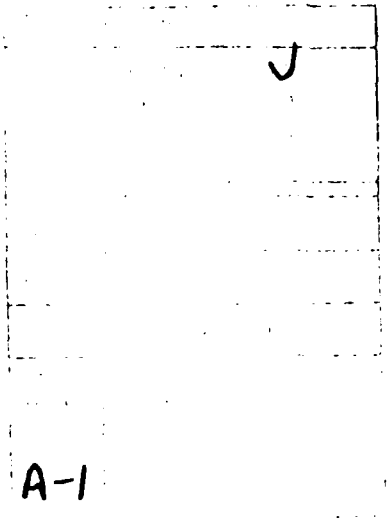
e. Foreign machine tools in the Army inventory.

f. Equipment replacement data.

2. The data used to prepare this study may be analyzed in a variety of ways that could be of benefit to the recipients of this study. Requests for further analysis or comments should be directed to the Industrial Engineering Activity point of contact, Ms. Nan Ramsey, AMXIB-IE, AUTOVON 793-5632 or commercial (309) 782-5632.

Encl

JOHN E. HOLVOET
Director, USA Industrial
Engineering Activity



AMXIB
SUBJECT: 1990 Vintage Study of Department of the Army Industrial Plant Equipment (IPE)

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# 1989 VINTAGE STUDY

## DEPARTMENT OF THE ARMY
## INDUSTRIAL PLANT EQUIPMENT
## (IPE)

PREPARED BY

NANNETTE M. RAMSEY
GENERAL ENGINEER

U.S. ARMY INDUSTRIAL ENGINEERING ACTIVITY
ROCK ISLAND ARSENAL
ROCK ISLAND, ILLINOIS 61299-7260

Any questions are welcomed at AUTOVON 793-5632 or
commercial (309) 782-5632.

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# EXECUTIVE SUMMARY

This study is an analysis of the inventory of Army owned Industrial Plant Equipment (IPE). The purpose of the study is to examine the trends and distribution of IPE within various categories, especially age. Unless otherwise noted, the data is obtained from the Army Industrial Equipment Data Base established in compliance with paragraph 5-3c(8), AR 700-90. The data base resides on an Amdahl 5880 mainframe at the Rock Island Arsenal and is maintained by the Industrial Engineering Activity (IEA). The Defense Industrial Plant Equipment Center (DIPEC) provides a tape to IEA on a monthly basis to update Army IPE records.

The total quantity of Army IPE has changed little in the last 6 years. A downward trend is anticipated in future years as plant closings and budget cuts along with fewer purchases of new equipment take effect. The Army inventory of active and inactive IPE consists of 41,223 items with an acquisition cost of $2.1 billion. The AMC inventory contains 94 percent of all Army IPE from a quantity viewpoint and 98 percent from an acquisition cost viewpoint. The majority of AMC's equipment is active, and AMC owns all the inactive Army IPE.

Age is not necessarily the best or exclusive trait for determining utility or fitness of equipment. Another indication of equipment usefulness can be obtained by looking at the condition code of equipment. This is a two digit code that reflects the condition of the equipment, based on: 1) a machine's ability to perform its function and 2) the cost of repair.

A summary of validated condition codes for inactive AMC equipment is provided in this study to present a view of equipment condition from a perspective other than age. Production equipment used by private industry as a whole is subjected daily to constant operation, necessitating earlier replacement. On the other hand, much of the Government equipment is used intermittently resulting in older equipment. Generally, newer equipment possesses improved operating characteristics; nevertheless, older equipment may perform acceptably depending on the function.

According to the 14th American Machinist Inventory published in November 1989, the average age of manufacturing equipment in private industry has gone down since their last inventory in November 1983. At the same time, the Army's inventory of metalcutting and metalforming equipment show an average age which has increased since the publication of the Army's Vintage Study in 1984.

As might be expected, much of the Army's newer equipment consists of Numerically Controlled (NC) machines. The average age for NC machines in the Army inventory is 10 years while the average age for non-NC machines is 26 years of age. However, the numerical control inventory of AMC, consisting of 1,466 items of IPE, is only 3.6 percent of the total inventory. The NC equipment acquisition cost of $424 million (replacement cost of $704 million) represents 20.6 percent of the total.

There has been increasing concern in the Government over the past several years regarding the supportability of foreign purchased machine tools in our industrial base, should a national emergency occur. Foreign machine tools are defined as being those machine tools where the cost of U.S. components is less than or equal to 50 percent of the cost of all components. An analysis of the Army inventory of IPE indicates that only 3.5 percent of the total number of Army machine tools are of foreign manufacture. This percentage is relatively low as a result of the high proportion of Army equipment that is older than 20 years. In that period, foreign competition in the machine tool industry was not significant. When applied only to the Army's NC equipment, which averages less than 10 years, the foreign manufacture percentage increases to 8 percent.

Extended lead time to purchase machine tools is another concern should a national emergency arise. This is one reason why the Army maintains Plant Equipment Packages (PEPs). PEPs are groups of Government-owned active and/or inactive IPE, other plant equipment, and special tooling/special test equipment items which have been approved by a military department or Defense Agency for retention to support surge/mobilization production requirements. The equipment is maintained in storage locations or active facilities across the country to reduce the time required to mobilize. The lead time to purchase new equipment is currently running up to 18 months for complex machining centers, in addition to an administrative lead time of 6 to 12 months for the Government to contract for the machine tool purchase. This administrative lead time would be reduced in times of national emergency; however, the time required to produce the machine could take longer due to increased demand.

## SECTION I

## OVERVIEW OF ARMY EQUIPMENT

An overview of Army-owned Industrial Plant Equipment (IPE) is presented in this section. It covers inventory trends, historical background, IPE age distribution, condition code, ownership by command, and equipment type and status.

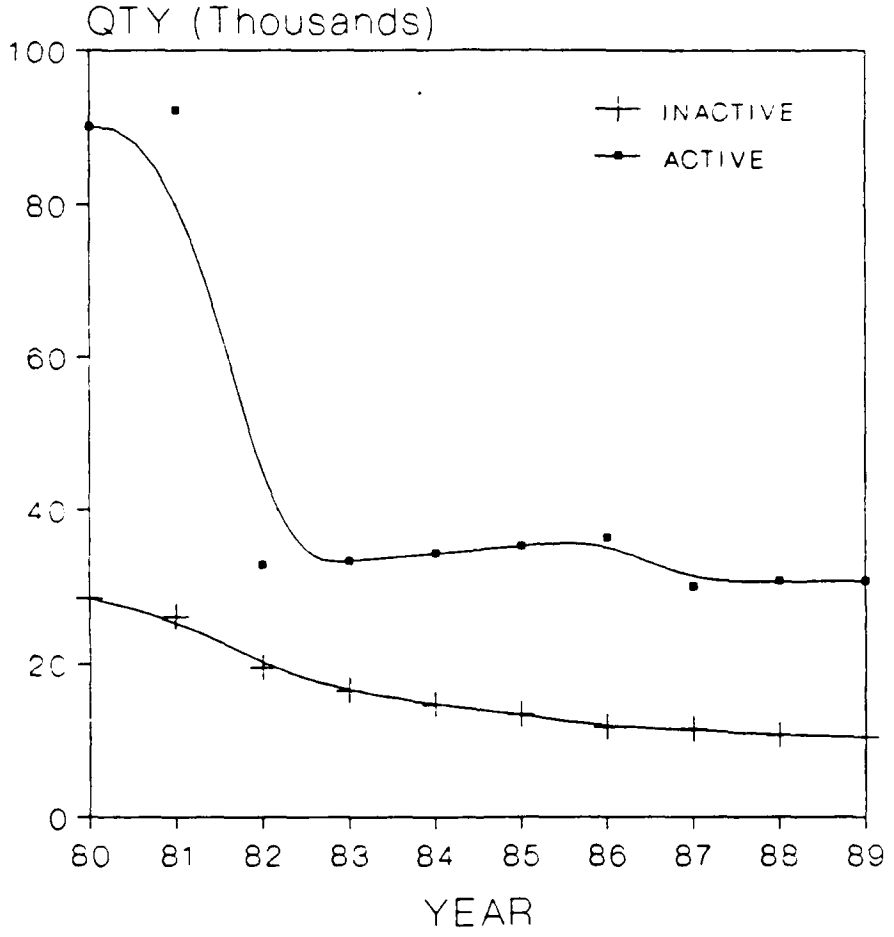
There has been little fluctuation of the Army inventory of IPE for the last 6 years. However, anticipated base closings and budget cuts along with fewer purchases of new equipment will most likely interrupt this trend. As of 30 August 1989, the Army inventory of IPE consisted of 41,223 items with an acquisition cost of $2.1 billion and an estimated replacement cost of $6.2 billion.

AMC manages 94 percent of the Army IPE, or 38,789 items. The percentages of active and inactive AMC equipment are 73.0 and 27.0 percent respectively. AMC is the only Army organization possessing Plant Equipment Packages (PEPs). PEPs are defined as Government-owned active and/or inactive industrial plant equipment which has been approved by a military department or Defense Agency for retention to support surge/mobilization production requirements. Therefore, AMC manages all Army "laidaway" IPE.

The inactive or "laidaway" IPE managed by AMC has an older age profile than the active equipment. Age, however, is not necessarily the best or exclusive trait for determining utility or fitness of equipment. Another indication of AMC equipment usefulness can be obtained by looking at the condition code of equipment. This is a two digit code that reflects the condition of the equipment, based on: 1) a machine's ability to perform its function and 2) the cost of repair. A table of condition codes used in this study are provided in Appendix A.

Verification of the codes assigned to inactive IPE was initiated in 1985 to insure conformance with the Defense Industrial Reserve Act of 1973 (PL 93-155). This Act established the requirement that PEPs be maintained in a high state of readiness. A DOD Inspector General Audit in 1984 revealed that PEPs were not in immediate use condition, thereby violating the 1973 Defense Industrial Reserve Act. As a result of the audit, condition assessments of inactive equipment were initiated in 1985. A condition assessment typically involves a team of men, experts in the rebuild field, traveling to the equipment site to inspect each individual piece of equipment. The team establishes the general physical state of the equipment and verifies or assigns a new condition code to indicate the actual physical state. A chart on the condition codes assigned to the inactive inventory is provided on page 8.

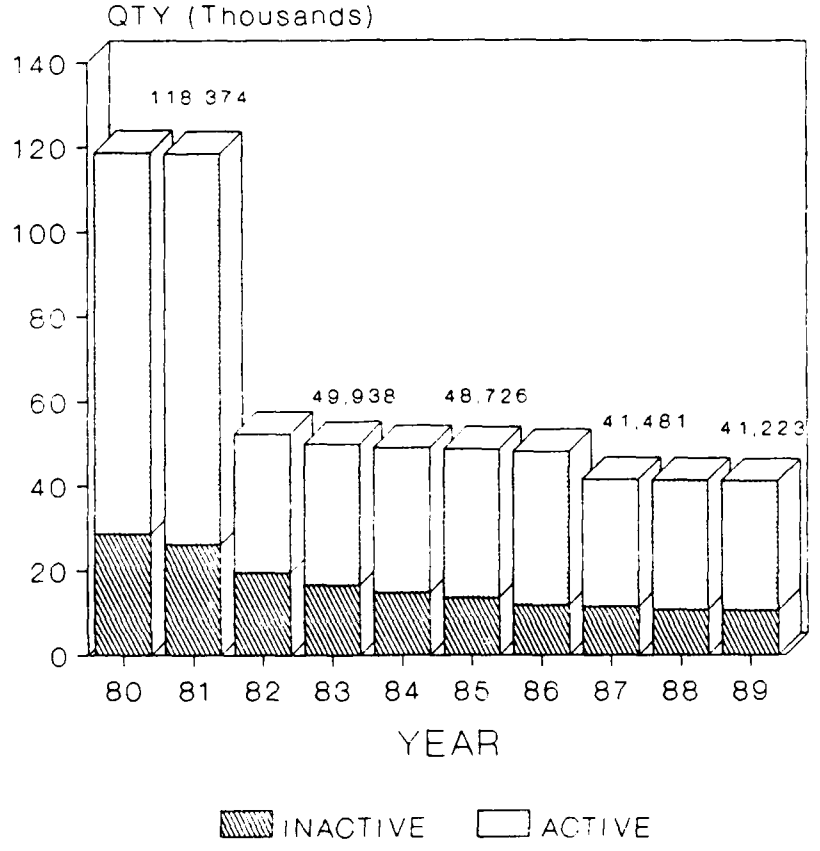
# INVENTORY TRENDS FOR DEPARTMENT OF THE ARMY IPE




AS OF 30 AUG 1989
SOURCE: DA CENTRAL INVENTORY OF IPE

This trend chart reflects the general inventory pattern of IPE over the the last 10 years. For the last 6 years, 1983 through 1989, there has been little fluctuation in the DA inventory of Industrial Plant Equipment (IPE). This continuity will most likely be interrupted by a gradual decline precipitated by plant closings and budget cuts. It is anticipated there will be fewer purchases of new equipment with the budget cuts. In addition, efforts to eliminate nonessential Plant Equipment Packages (PEPs) are ongoing as Operational Maintenance Army (OMA) funds are cut and the ability to maintain laidaway equipment and buildings is diminished.

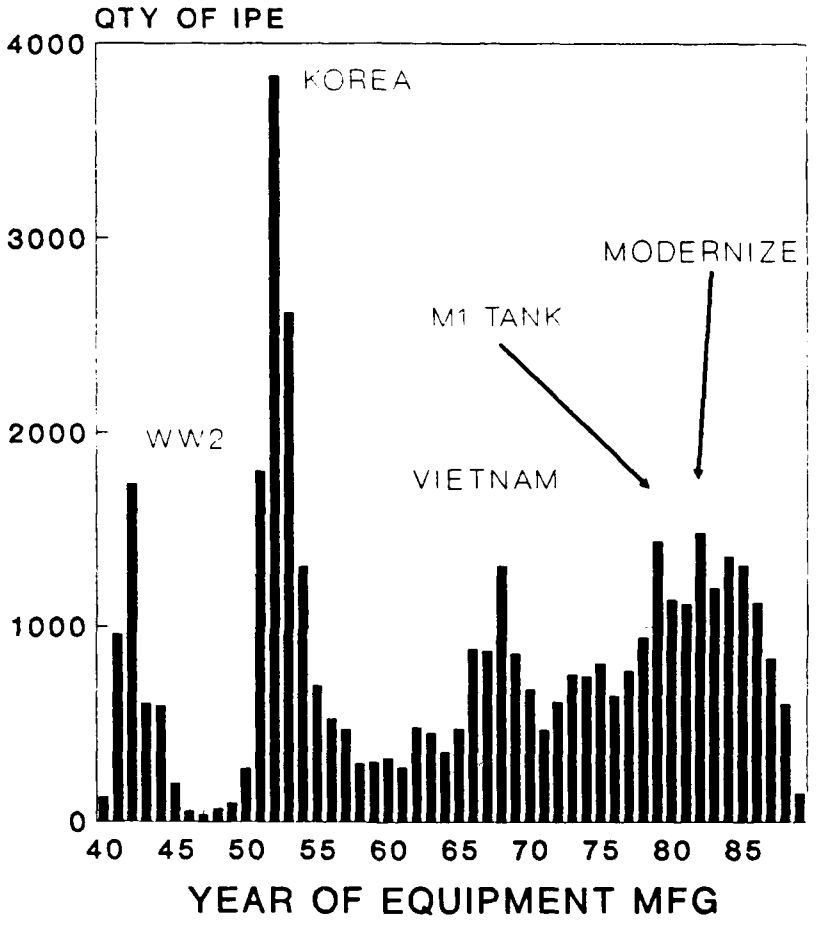
# DEPARTMENT OF THE ARMY
# INVENTORY OF IPE




AS OF 30 AUG 1989
SOURCE DA CENTRAL INVENTORY OF IPE

The figure above shows, by year, the total quantity of Army IPE. The drastic decline shown in 1982 can be attributed to the decontrol of numerous items of IPE. In 1982, the definition of Industrial Plant Equipment (IPE) changed from having an acquisition cost threshold of $1,000 to a threshold of $5,000 for contractors and $3,000 for in-house activities. Equipment in these acquisition cost ranges was reclassified as Other Plant Equipment (OPE). In addition, 19 Federal Supply Classes were deleted from inclusion as IPE in 1982. The minor variation in 1987 transpired when the IPE threshold for in-house activities was again raised, this time from $3,000 to $5,000 in an effort to standardize management levels. Another contributing factor to the 1987 decline was the elimination of four large Plant Equipment Packages (PEPs) containing equipment for the M60 tank.

# AGE DISTRIBUTION OF INDUSTRIAL PLANT EQUIPMENT

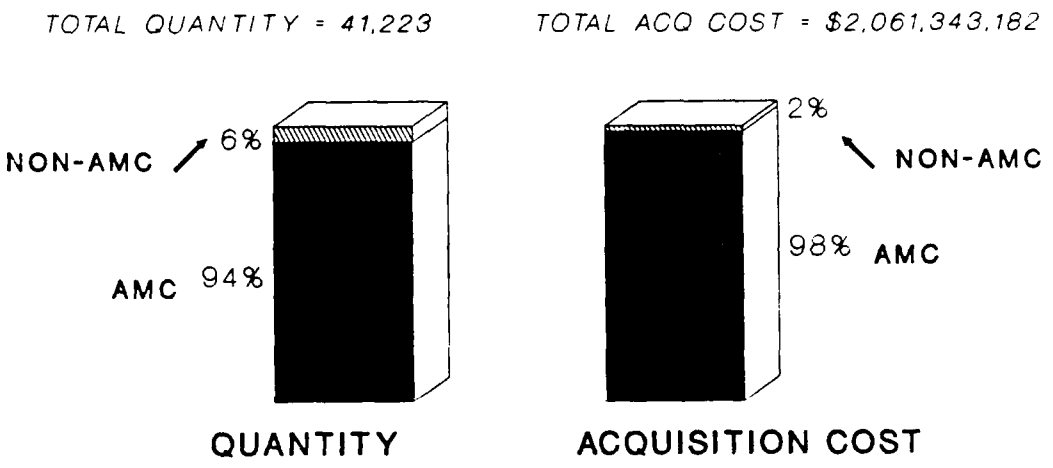



AS OF 30 AUGUST 1989

This graph shows the year of manufacture for metalworking equipment in the Army inventory manufactured after 1940. There is equipment in the inventory built prior to 1940 but it accounts for one half of one percent of the inventory and has not been included in this graph. Spikes in the graph prior to 1970 indicate tooling purchases as the Army geared up to supply war efforts. Notice that the spikes tend to occur 2 to 3 years into the war due to the lead time to purchase IPE and the competing material needs of the industrial base. The gradual increasing trend from 1975 to the early eighties were a reflection of the following: the Army invested in REARM programs to modernize the Government arsenals at Rock Island, IL and Watervliet, NY; new machine tools had to be purchased which were capable of producing to the close tolerances required by new weapons systems such as the M1; and the establishment of the Mississippi Army Ammunition Plant. In 1986, the quantities of machine tools purchased appears to drop off drastically. The figures on equipment quantities purchased from 1986 to the present can be misleading due to several factors. These factors are enumerated on the following page.

There are two major factors which impede an accurate accounting of recent purchases of machine tools. First, there is a lead time involved in the purchase of equipment. A machine purchased in 1988 may not be received from the manufacturer until 1989. Secondly, time is required for the property administrator to process the DD Form 1342. This is the form which is sent to the Defense Industrial Plant Equipment Center (DIPEC), to indicate the addition of the machine to the Army production base. Upon the receipt of the form at DIPEC, the form is reviewed for accuracy and the data is entered into the IPE data base. If the DD Form 1342 is incorrect when it reaches DIPEC, time is required for DIPEC to establish the correct information. Notable delays have occurred in the past, postponing entry into into the data base by more than a year. Therefore, inventory figures for recent years (1986 to 1989) should be viewed with these delays in mind.

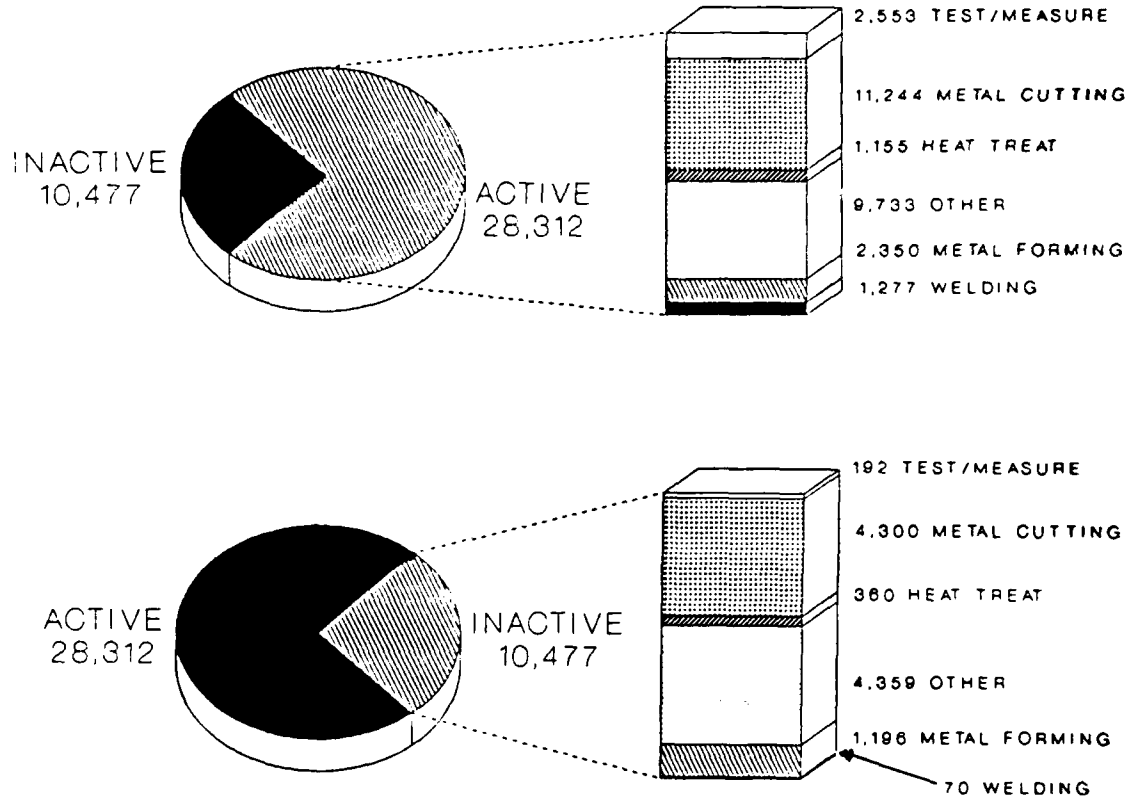
# INDUSTRIAL PLANT EQUIPMENT OWNERSHIP




AS OF 30 AUG 1989

The Department of the Army inventory of Industrial Plant Equipment (IPE) consists of 41,223 items with a combined acquisition value of $2.1 billion and an approximate combined replacement value of $6.7 billion. The average acquisition cost for the August 1989 inventory of IPE is $50,000, with acquisition values ranging from $5,000 to $6,749,185. The Army Materiel Command (AMC) owns 94 percent of all IPE from a quantity viewpoint, up 8 tenths of a percent from last year. They own 98 percent from an acquisition cost viewpoint, up 9 tenths of a percent from last year. Clearly, AMC is the major user of IPE within the Army, and it is reasonable to consider AMC as being representative of the Army.

# AMC EQUIPMENT
## ACTIVE vs. INACTIVE

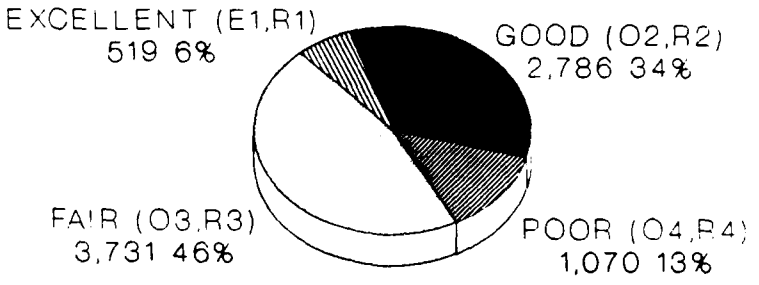



AS OF 30 AUG 1989

The majority of the 38,789 pieces of Industrial Plant Equipment (IPE) owned by AMC are active, or 73.0 percent. AMC is the only Army organization possessing plant equipment packages (PEPs). Therefore, AMC owns all laid away Army IPE.

The "other" equipment category shown above, is composed of a variety of miscellaneous equipment including; metal finishing tanks, barrel finishing machines, plastic injection molding machines, chemical pelletizers, bonding machines, trimming machines, fusing machines, dipping machines, and marking machines in addition to many other ammunition peculiar equipment.

# INACTIVE EQUIPMENT CONDITION
## BASED ON CONDITION ASSESSMENTS

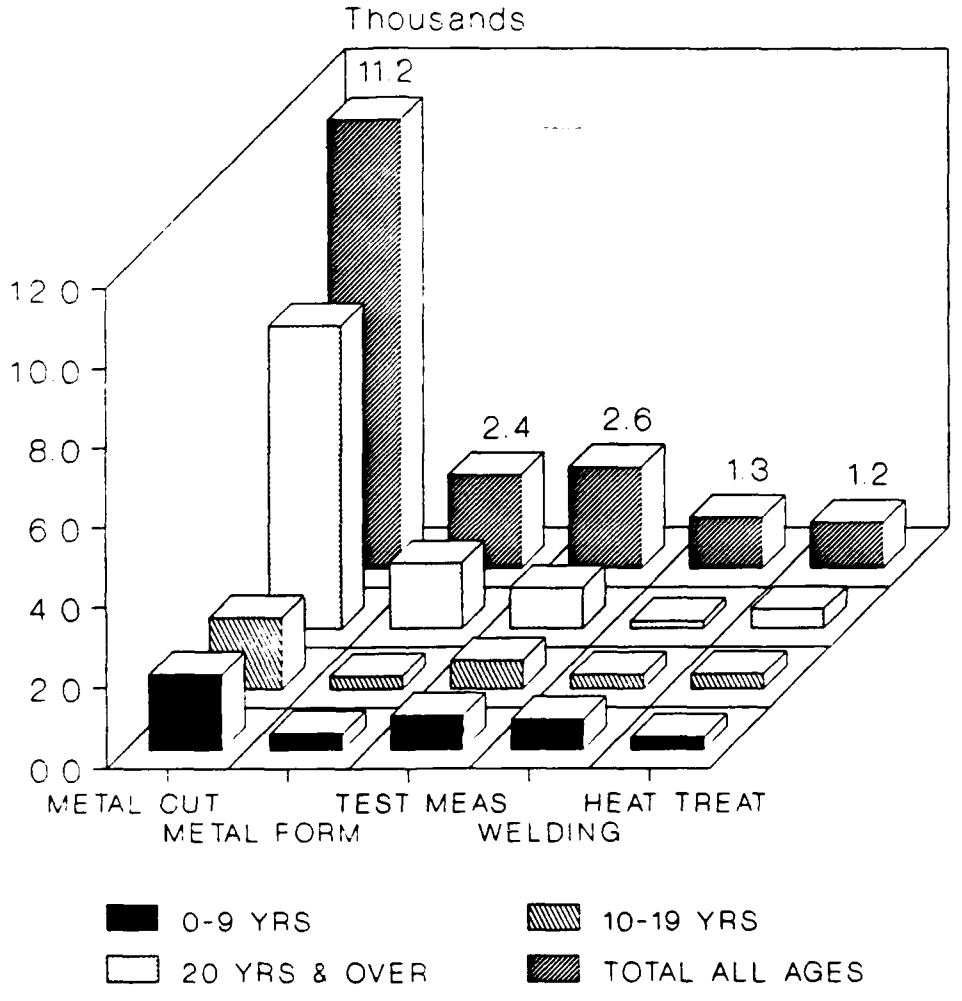



As of 30 Sep 1989

AR 700-90 directs all equipment to be in O2 condition or better prior to layaway. However, the common practice at the end of a production run is to select the oldest and least dependable IPE items for layaway. In the case of inactive equipment, physical degradation abates at the time of layaway when a layaway is properly performed. Yet it is obvious from the graph above that fifty-nine percent of the equipment in layaway is currently in less than O2 condition. This is a good indication that equipment placed in layaway is not conforming to the regulations.

Condition assessments were completed for all IPE at central storage sites in 1988 and are expected to be completed at planned producers in FY 91. There have been 8,106 items of existing inactive IPE condition assessed as of 30 Sept 1989.

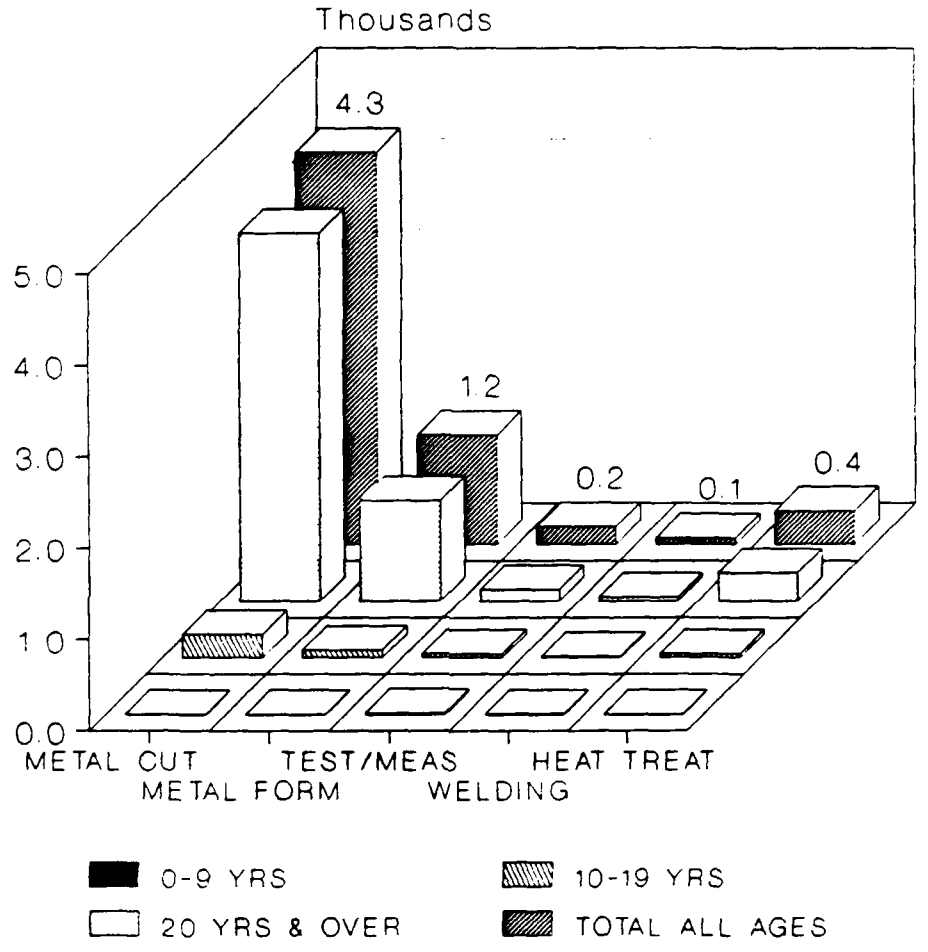
# AMC ACTIVE EQUIPMENT
## AGE




AS OF 30 AUG 1989

This figure divides active Industrial Plant Equipment (IPE) into five major classes of IPE including metalcutting, metal forming, mechanical test and measuring, welding, and heat treat/furnaces. In the AMC active inventory, the metalcutting category is unmistakably the largest.

# AMC INACTIVE EQUIPMENT
## AGE




AS OF 30 AUG 1989

This figure divides inactive Industrial Plant Equipment (IPE) into the same five classes as the previous figure. Note that inactive equipment has an older age profile than does the active equipment. Also note that metalcutting equipment has the oldest age profile shown for both active (p. 9) and inactive equipment while welding has the youngest. This can be attributed to the shorter useful life of welding equipment and longer useful life of metalcutting equipment.

## SECTION II

## AMC/INDUSTRY COMPARISON

An age comparison of AMC and private industry equipment is shown in this chapter for IPE classes of metalcutting, metalforming, and welding/joining. Mechanical test and measuring equipment and heat treat equipment are excluded from this section due to the unavailability of historical data. The Federal Supply Classes (FSC) for each type of equipment included in this chapter are listed in Appendix B. All data in this section is presented as a percentage of the total quantity of equipment for a specific class.

According to the 14th American Machinist Inventory published in November 1989, the average age of manufacturing equipment in private industry has gone down for the last two inventories (13th and 14th), conducted six years apart *. In 1945, following the emergency tooling for war production, 62 percent of metalcutting machines were less than ten years old. This percentage had declined steadily since then, except for a rise of 1 percent following the first enactment of the investment tax credit in 1962. The investment tax credit, a special stipulation in the U.S. Internal Revenue Laws, allowed businesses to deduct a certain percentage of the dollar cost of new investment as a credit against income taxes. This encouraged corporate investment.

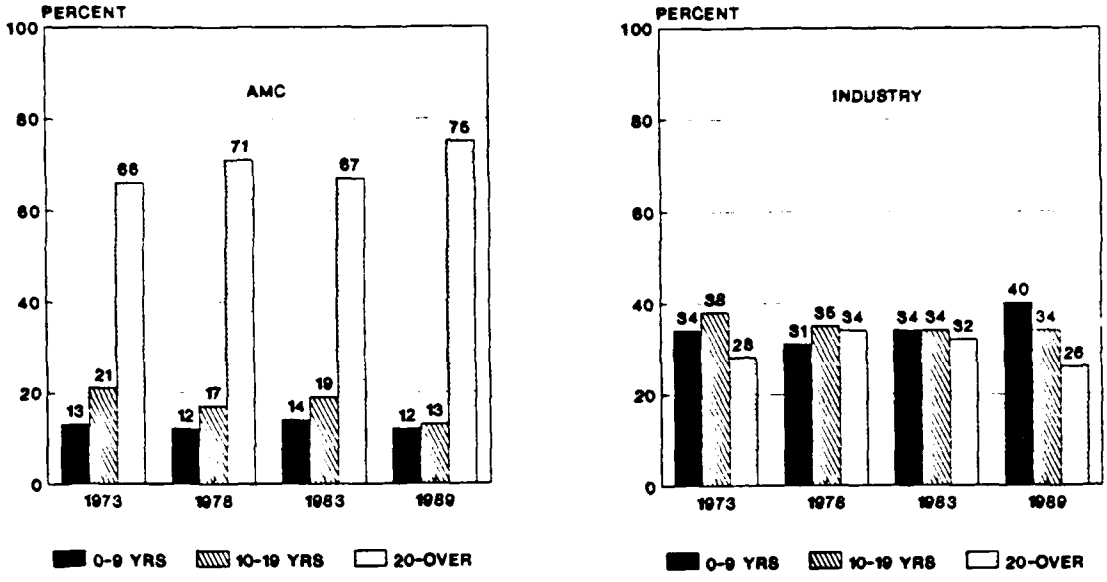
Aside from this 1 percent rise, the first indication of a reversal of this trend toward aging equipment was in the 13th American Machinist Inventory in November of 1983. With the 14th American Machinist Inventory, it appears the trend toward a younger average equipment age in private industry is continuing.

Government equipment does not follow the same trend. Both metalcutting and metalforming equipment have an increased average age compared to the 1984 Vintage Study data. Welding equipment is the only category in this study with a lower average age in comparison to the 1984 study.

In this section of the Vintage Study, there are two types of chart formats. One format reflects data for the years 1973 through 1989 and combines current and historical data to assist in the visualization of any trends. The second type of format focuses on 1989 data and segments AMC equipment into two divisions: active equipment only and both active and inactive equipment grouped together. In addition to providing a more realistic comparison of how Army production equipment age currently in use is keeping pace with industry, this format also shows active and a combination of active and inactive data side-by-side in the chart, revealing the significantly greater age of inactive equipment.

* Normally, the American Machinist Inventory is published at 5 year intervals. The 14th inventory was delayed one year and published in November 1989.

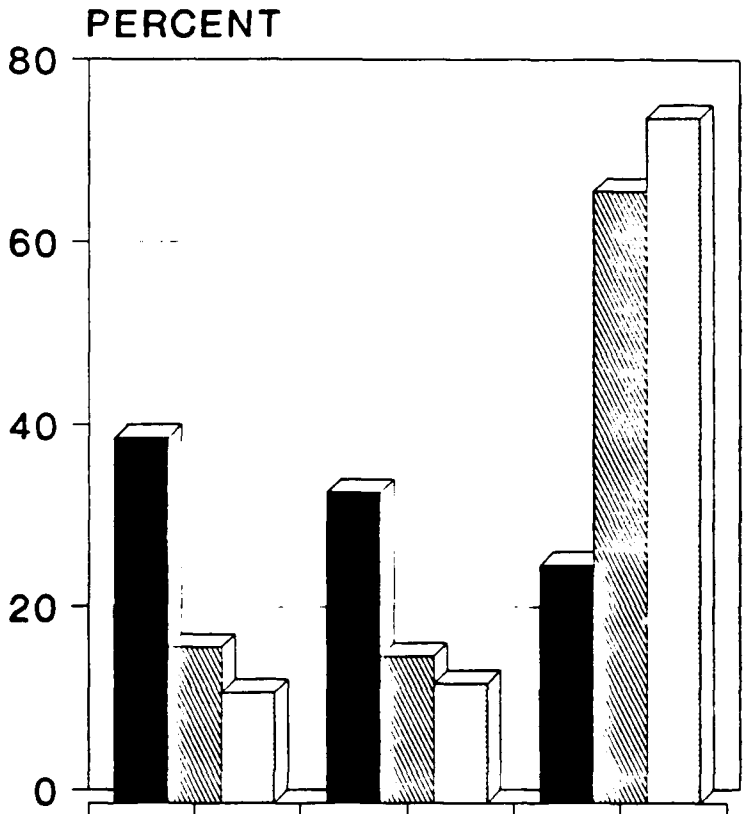
# AMC vs. INDUSTRY TRENDS
# AGE COMPARISON
## METALCUTTING EQUIPMENT




In the industry chart above, note the relatively consistent height of the bars compared to that of the AMC chart. This denotes the steady investment in equipment by industry over the years. AMC on the other hand has a significantly older inventory of machine tools. This can be attributed to Government production requirements which tend to swing radically with national emergencies. It has been more than 15 years since the United States has had a significant need for war materials. Industry on the other hand, as a whole tends to have constant requirements for production. The number of industry machine tools in the relatively modern age group (0-9 yrs) has grown from 34 percent in 1983 to 40 percent as the nation continues on the longest peacetime expansionary period in history. In the same age group, the percentage has decreased for Government equipment, going from 14 percent in 1983 to 12 percent in 1989.

# METALCUTTING EQUIPMENT AGE COMPARISON AMC vs. INDUSTRY

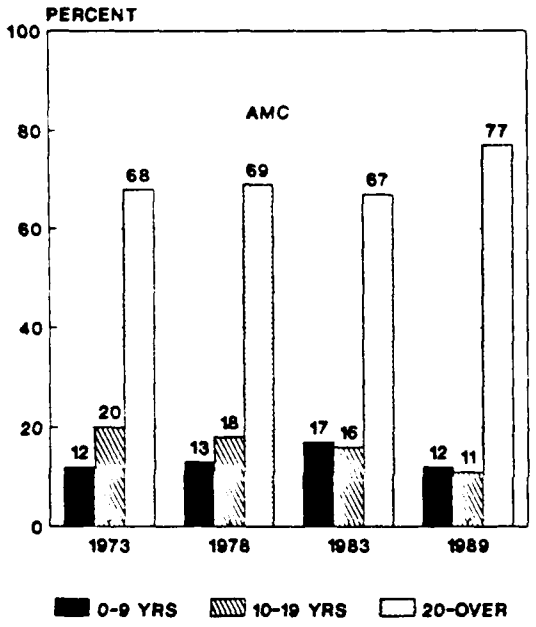
The pattern between AMC and industry in this chart is almost diametric. While industry has a greater percentage of metalcutting equipment in the younger age category with decreasing percentages in each progressively older category, both categories of AMC equipment have smaller percentages of equipment in the youngest age category with increasing percentages in the progressively older age categories (except for 10-19 years, AMC active). This distribution reflects negatively in terms of AMC keeping pace with industries' investment in metalcutting machine tools.

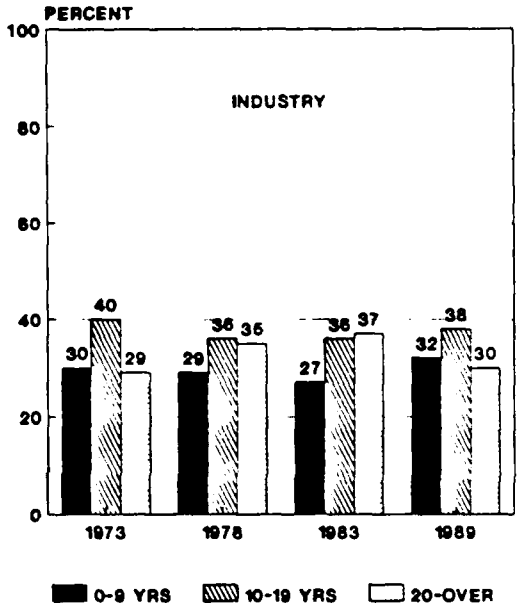



| | 0-9 YRS | 10-19 YRS | 20-OVER |
|---|---|---|---|
| INDUSTRY | 40 | 34 | 26 |
| AMC ACTIVE | 17 | 16 | 67 |
| AMC ACTIVE & INACT. | 12 | 13 | 75 |

INDUSTRY DATA EXTRACTED FROM
14TH AMERICAN MACHINIST INVENTORY
AS OF 30 JUNE 1989

# AMC vs. INDUSTRY TRENDS
# AGE COMPARISON
## METALFORMING EQUIPMENT

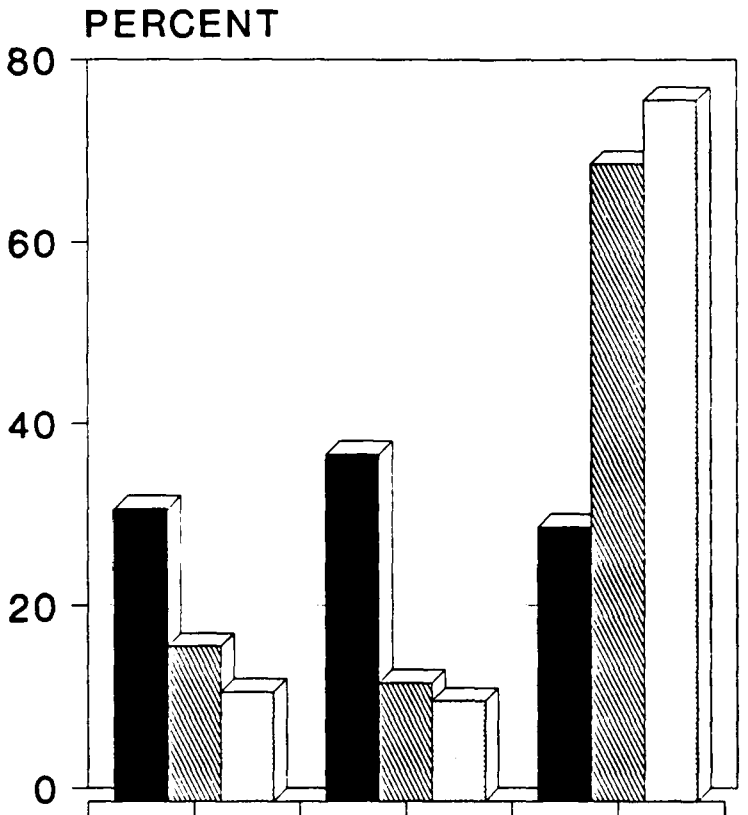



For the metalforming equipment shown above, note the jump in the column for the 20 and over age group for AMC equipment. This can be attributed to a great extent to equipment in Plant Equipment Packages (PEPs) which have been laidaway up to 33 years. Add that to the age of the equipment when it went into layaway and the reason for the jump becomes evident. However, as previously mentioned, age is not necessarily the best or only criteria to determine usefulness or capability. Other factors such as use and maintenance strongly influence a machine's serviceability. In the case of inactive equipment, while physical degradation slackens at the time of layaway; obsolescence does not. Age is often a good indicator of the operating characteristics and production capabilities of equipment. It is obvious from this section that industry is taking greater advantage of the improvements in manufacturing that technology has wrought.

# METALFORMING EQUIPMENT AGE COMPARISON AMC vs. INDUSTRY

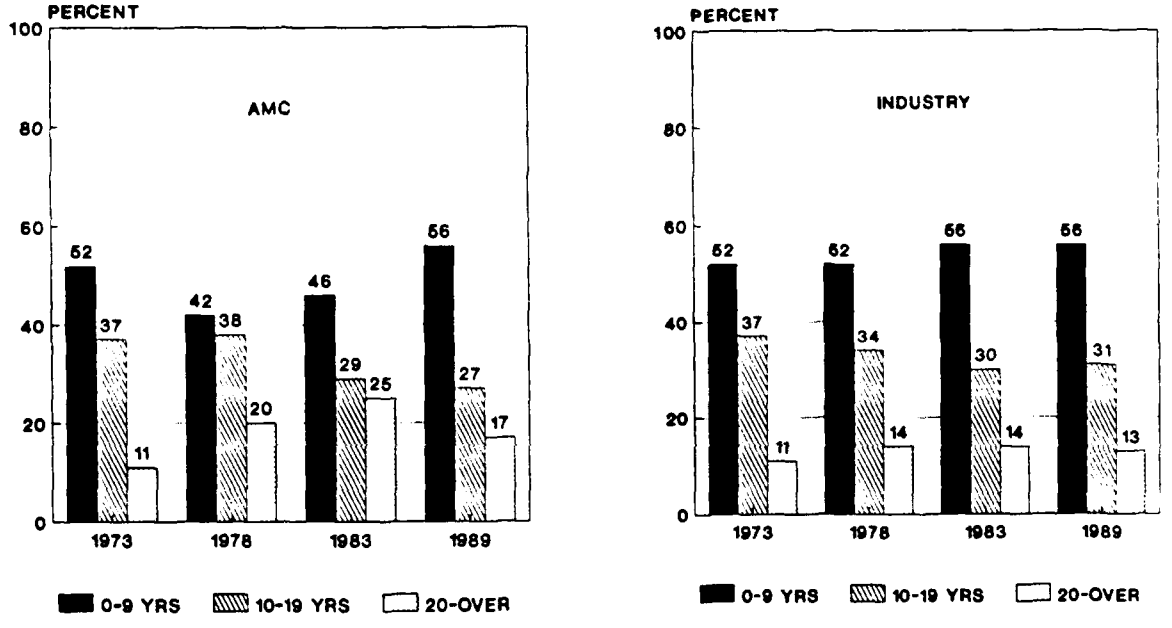
A closer analysis of the 1989 metalforming age profile breaks AMC equipment into active only and active and inactive equipment combined. AMC active equipment is significantly younger than the combined category of active and inactive equipment. Still, industry has a substantially younger age profile than AMC active equipment shown here.




| | 0-9 YRS | 10-19 YRS | 20-OVER |
|---|---|---|---|
| INDUSTRY | 32 | 38 | 30 |
| AMC ACTIVE | 17 | 13 | 70 |
| AMC ACTIVE & INACT. | 12 | 11 | 77 |

INDUSTRY DATA EXTRACTED FROM
14TH AMERICAN MACHINIST INVENTORY
AS OF 30 JUNE 1989

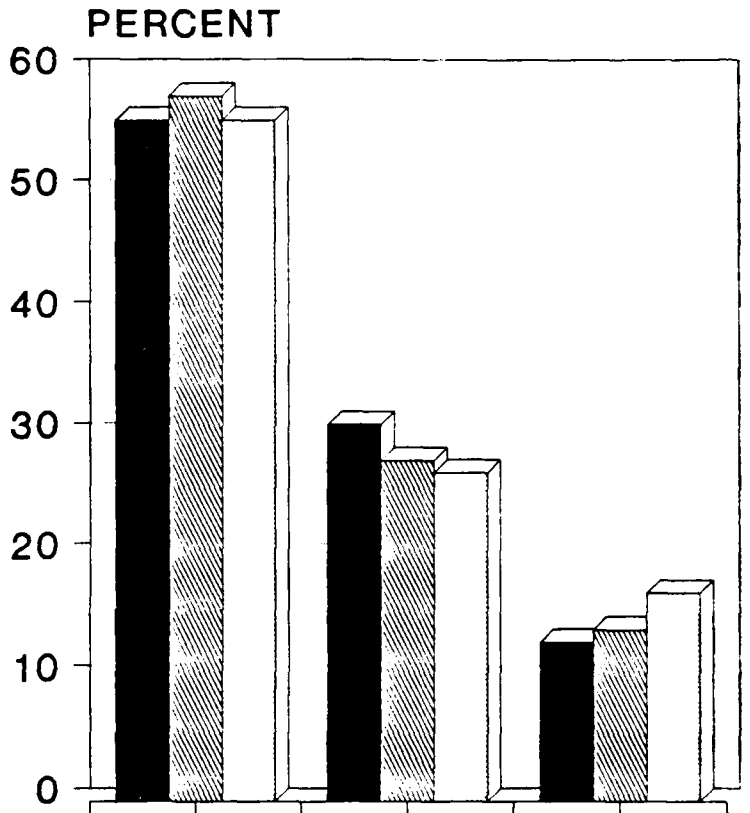
# AMC vs. INDUSTRY TRENDS
# AGE COMPARISON
## WELDING EQUIPMENT




Welding equipment is the exception in the comparison of equipment age between AMC and industry. Note the similar heights and drifts of the bars in this chart. AMC and industry welding equipment have comparable age profiles. The shorter useful life of welding equipment, requiring earlier replacement, seems to be a major reason for this similarity.

# WELDING EQUIPMENT AGE COMPARISON AMC vs. INDUSTRY

AMC active equipment has a slightly younger age profile than industry. Inactive and active welding equipment combined have a slightly less favorable age profile than industry.




| | 0-9 YRS | 10-19 YRS | 20-OVER |
|---|---|---|---|
| INDUSTRY | 56 | 31 | 13 |
| AMC ACTIVE | 58 | 28 | 14 |
| AMC ACTIVE & INACT. | 56 | 27 | 17 |

INDUSTRY AMC ACTIVE
AMC ACTIVE & INACT.

INDUSTRY DATA EXTRACTED FROM
14TH AMERICAN MACHINIST INVENTORY
AS OF 30 JUNE 1989

## SECTION III

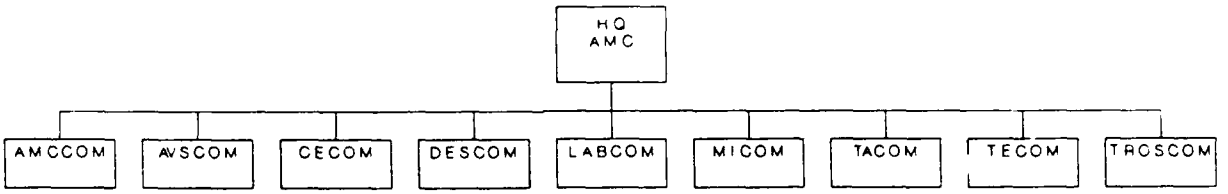
## EQUIPMENT STATUS WITHIN AMC

This section presents the age distribution for five types of Industrial Plant Equipment (IPE) for each of the AMC Major Subordinate Commands (MSCs). The age distribution is portrayed for three age categories, 0-9 years, 10-19 years, and 20 and over for each type of equipment including metalcutting, metal forming, mechanical test and measure, welding, and heat treat/furnaces. These age distributions are presented for both active and inactive equipment. The various equipment types are gathered by Federal Supply Class (FSC) which can be found in Appendix B.

In the following graphs you will note that, with only one exception, AMCCOM manages the preponderance of each class of Army owned equipment. AMCCOM is the single item manager for conventional ammunition for the entire Department of Defense. The Government owns the majority of equipment at AMCCOM managed facilities, because of the unique nature of military ammunition relative to items such as transmissions or aircraft parts.

AMCCOM and AVSCOM have the only PEP equipment; therefore, these are the only two commands you will see managing inactive equipment on the following charts.

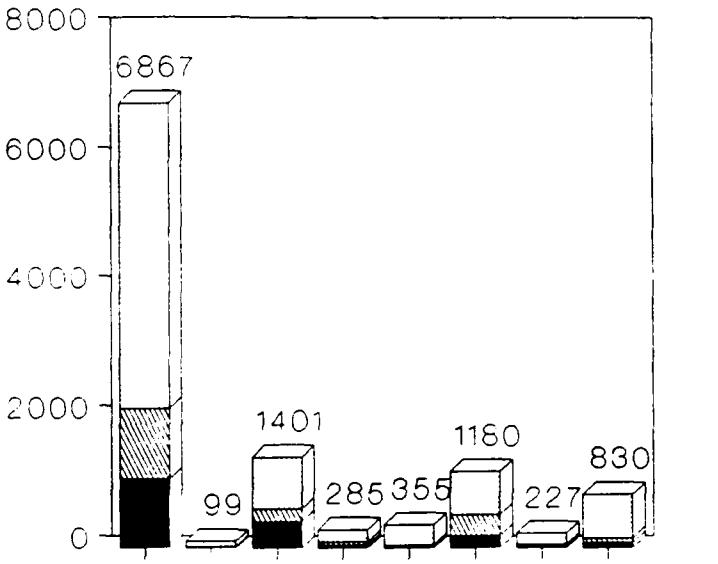
# HQ AMC
## ORGANIZATIONAL CHART





There are nine MSCs under HQ AMC. Definitions for each command acronym are as follows: AMCCOM - Armament Munitions & Chemical Command, AVSCOM - Aviation Systems Command, CECOM - Communication-Electronics Command, DESCOM - Depot Systems Command, LABCOM - Laboratory Command, MICOM - Missile Command, TACOM - Tank & Automotive Command, TECOM - Test & Evaluation Command, and TROSCOM - Troop Support Command.

# MAJOR SUBORDINATE COMMANDS
## ACTIVE METALCUTTING EQUIPMENT



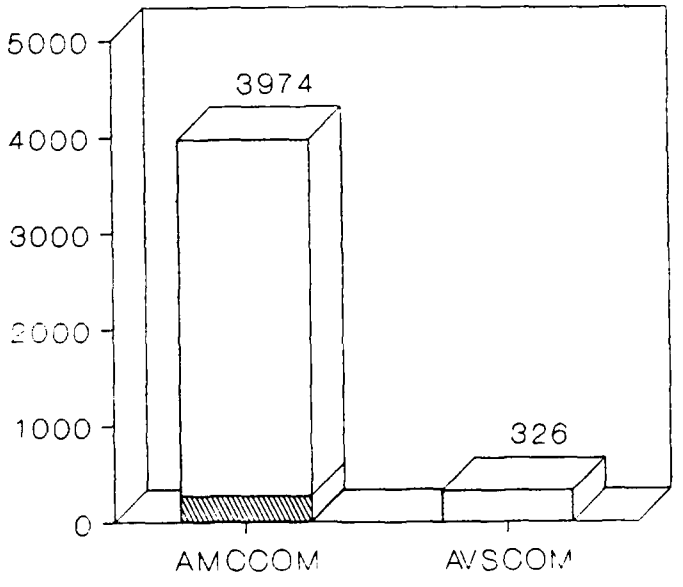

| | AMCCOM | DESCOM | CECOM | LABCOM | MICOM | TECOM | TACOM | TROSCOM & AVSCOM |
|---|---|---|---|---|---|---|---|---|
| 20 YRS & OVER | 4722 | 79 | 800 | 187 | 307 | 666 | 173 | 674 |
| 10-19 YRS | 1079 | 16 | 197 | 56 | 17 | 322 | 8 | 75 |
| 0-9 YRS | 1066 | 4 | 404 | 42 | 31 | 192 | 46 | 81 |

0-9 YRS  10-19 YRS  20 YRS & OVER

AS OF 30 AUG 1989

The quantity of active machine tools in the Federal Supply Classes for metalcutting machine tools (see Appendix A) are graphed above for each command. The quantity of equipment has decreased in the last five years, an average of 15 percent for each command. AMCCOM manages the majority of active metalcutting equipment at 61 percent. DESCOM is a distant second managing 12 percent of the inventory.

# MAJOR SUBORDINATE COMMANDS
## INACTIVE METALCUTTING EQUIPMENT



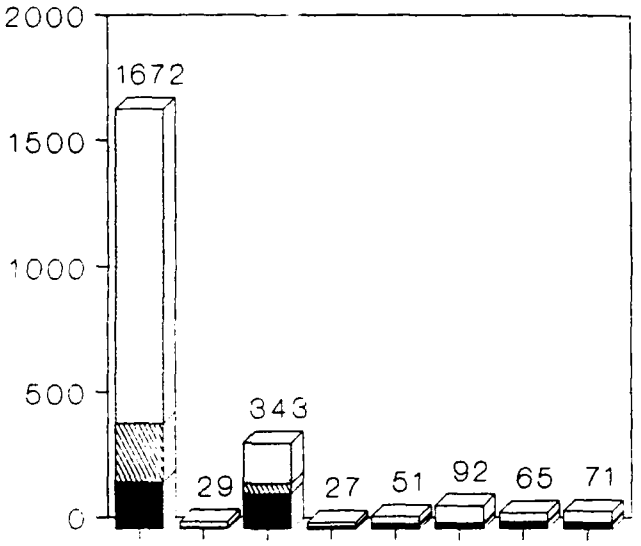

| | | |
|---|---|---|
| 20 YRS & OVER | 3702 | 326 |
| 10-19 YRS | 263 | 0 |
| 0-9 YRS | 9 | 0 |

0-9 YRS  10-19 YRS
20 YRS & OVER

AS OF 30 AUG 1989

AMCCOM has the bulk of the inactive metalcutting equipment with 92 percent of the inventory, 93 percent of which is 20 years of age or older. All of AVSCOM's inactive metalcutting equipment falls into the 20 years and over category.

# MAJOR SUBORDINATE COMMANDS
## ACTIVE METALFORMING EQUIPMENT



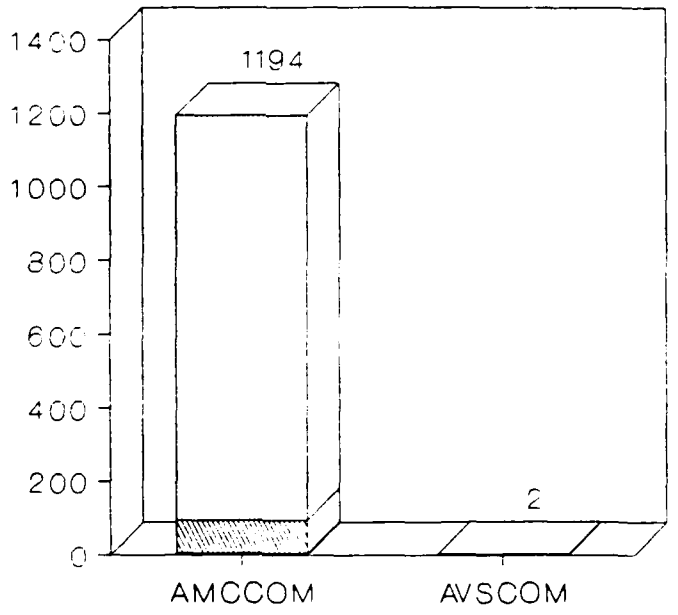

| | AMCCOM | DESCOM | CECOM | LABCOM | MICOM | TACOM | TECOM | TROSCOM & AVSCOM |
|---|---|---|---|---|---|---|---|---|
| 20 YRS & OVER | 1251 | 22 | 161 | 15 | 29 | 69 | 36 | 45 |
| 10-19 YRS | 235 | 6 | 42 | 6 | 9 | 7 | 4 | 7 |
| 0-9 YRS | 186 | 1 | 140 | 6 | 13 | 16 | 25 | 19 |

0-9 YRS  10-19 YRS
20 YRS & OVER

AS OF 30 AUG 1989

AMCCOM manages 71 percent of the active metalforming equipment in the AMC inventory, and 75 percent of the AMCCOM inventory is 20 years of age or older. DESCOM manages 15 percent, with CECOM, LABCOM, MICOM, TACOM, TECOM, TROSCOM, and AVSCOM managing the remaining 14 percent of the inventory.

# MAJOR SUBORDINATE COMMANDS
## INACTIVE METALFORMING EQUIPMENT

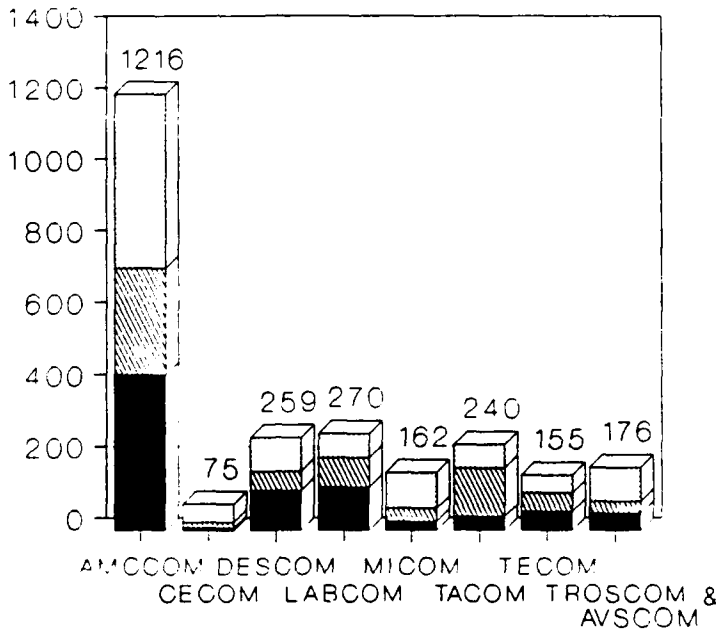



| | AMCCOM | AVSCOM |
|---|---|---|
| 20 YRS & OVER | 1100 | 2 |
| 10-19 YRS | 89 | 0 |
| 0-9 YRS | 5 | 0 |


AS OF 30 AUG 1989

Nearly 100 percent of the inactive metalforming equipment is controlled by AMCCOM and 92 percent of it is over 20 years of age or older. This is a very similar to the age profile of inactive metalcutting equipment shown earlier in this study on page 21.

# MAJOR SUBORDINATE COMMANDS
## ACTIVE MECH TEST & MEAS EQUIPMENT



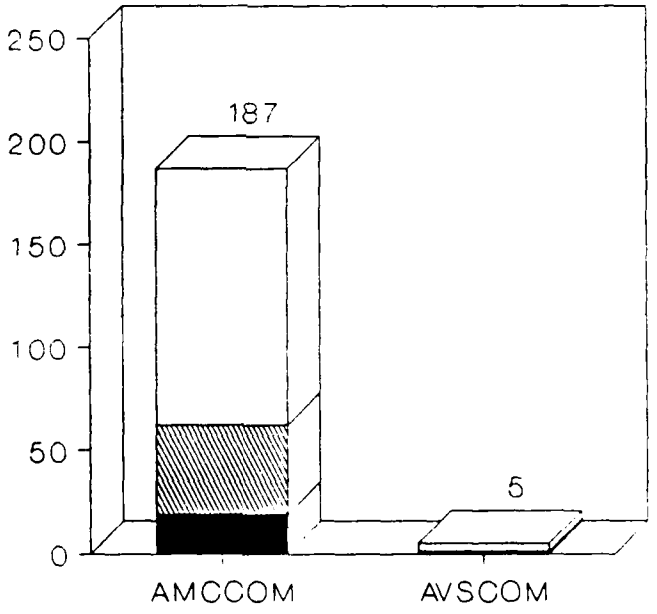

| | AMCCOM | DESCOM | CECOM | LABCOM | MICOM | TACOM | TECOM | TROSCOM & AVSCOM |
|---|---|---|---|---|---|---|---|---|
| 20 YRS & OVER | 486 | 51 | 94 | 68 | 100 | 65 | 50 | 94 |
| 10-19 YRS | 296 | 17 | 52 | 81 | 36 | 136 | 51 | 34 |
| 0-9 YRS | 434 | 7 | 113 | 121 | 26 | 39 | 54 | 48 |

0-9 YRS  10-19 YRS  20 YRS & OVER

AS OF 30 AUG 1989

The equipment in this graph displays a significantly younger age profile than active metalcutting and metalforming equipment. Thirty-three percent of the active mechanical test and measuring equipment falls into the 0-9 years of age category, and 40 percent are past their prime at 20 years of age or older. This can be attributed to a shorter life span for test and measuring equipment, necessitating more frequent replacement.

# MAJOR SUBORDINATE COMMANDS
## INACTIVE MECH TEST & MEAS EQUIP



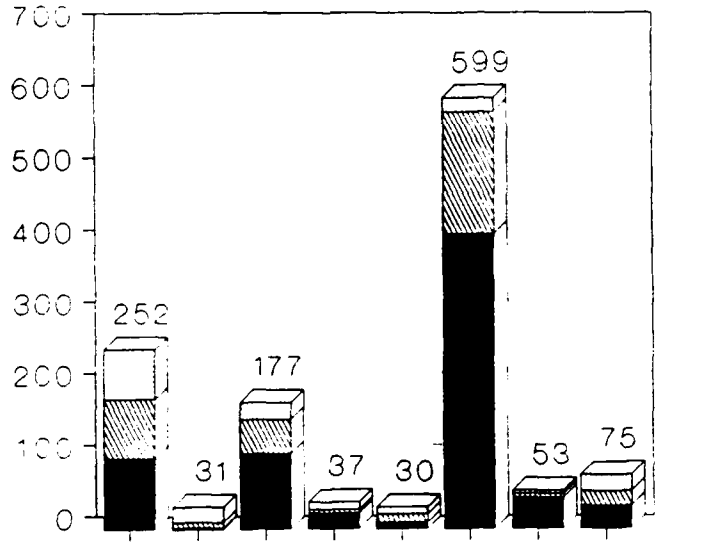

| | AMCCOM | AVSCOM |
|---|---|---|
| 20 YRS & OVER | 125 | 4 |
| 10-19 YRS | 43 | 1 |
| 0-9 YRS | 19 | 0 |

0-9 YRS  10-19 YRS  20 YRS & OVER

AS OF 30 AUG 1989

As with the other types of equipment shown thus far, AMCCOM manages the vast majority of inactive mechanical test and measuring equipment, more precisely, 97 percent.

# MAJOR SUBORDINATE COMMANDS
## ACTIVE WELDING EQUIPMENT



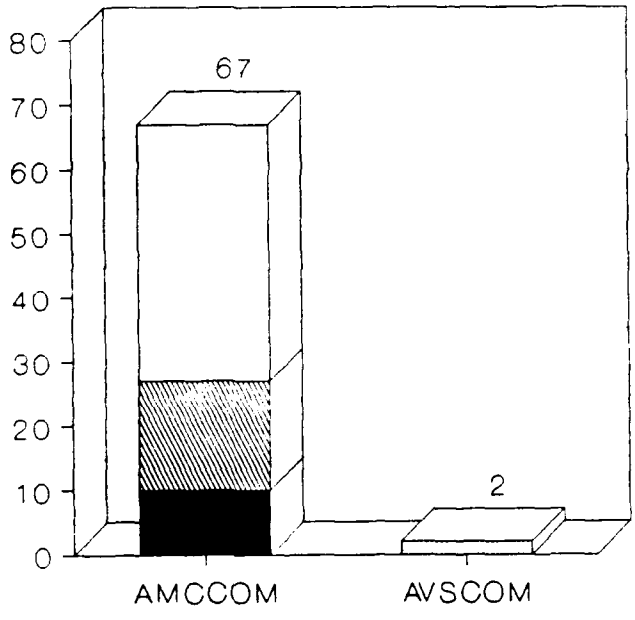

| | AMCCOM | CECOM | DESCOM | LABCOM | MICOM | TACOM | TECOM | TROSCOM & AVSCOM |
|---|---|---|---|---|---|---|---|---|
| 20 YRS & OVER | 70 | 21 | 24 | 10 | 10 | 19 | 4 | 23 |
| 10-19 YRS | 83 | 8 | 48 | 5 | 11 | 169 | 6 | 20 |
| 0-9 YRS | 99 | 2 | 105 | 22 | 9 | 411 | 43 | 32 |

0-9 YRS  10-19 YRS  20 YRS & OVER

AS OF 30 AUG 1989

Management of active welding equipment is dominated by TACOM, which has 48 percent of the inventory in their charge. This can be attributed to the fact that the items for which TACOM is responsible generally require more welding than items managed by other commands, i.e. much of the welding equipment is at the Lima Army Tank Plant, where the hull of the M1 Abrams is welded. Also notable in this graph is the younger age profile of welding equipment in comparison to all other types of IPE in this study. Fifty-seven percent of the active welding equipment is relatively young, under 10 years old. As with test and measuring equipment, this can be attributed to the shorter life span of welding equipment and the need for more frequent replacement.

# MAJOR SUBORDINATE COMMANDS
## INACTIVE WELDING EQUIPMENT

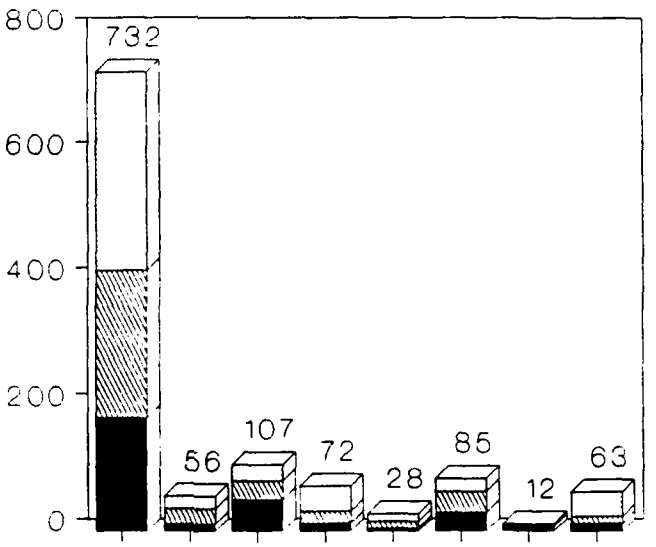



| | AMCCOM | AVSCOM |
|---|---|---|
| 20 YRS & OVER | 40 | 2 |
| 10-19 YRS | 17 | 0 |
| 0-9 YRS | 10 | 0 |


AS OF 30 AUG 1989

Inactive welding equipment has a younger age profile than all other inactive equipment. Again, this is accounted for by the shorter life span of welding equipment. Unlike the active welding equipment, where TACOM manages the bulk of the inventory, AMCCOM retains nearly 100 percent of the inactive welding inventory. This has been true since 1987, when the tank PEPs managed by TACOM were eliminated.

# MAJOR SUBORDINATE COMMANDS
## ACTIVE HEAT TREAT EQUIPMENT



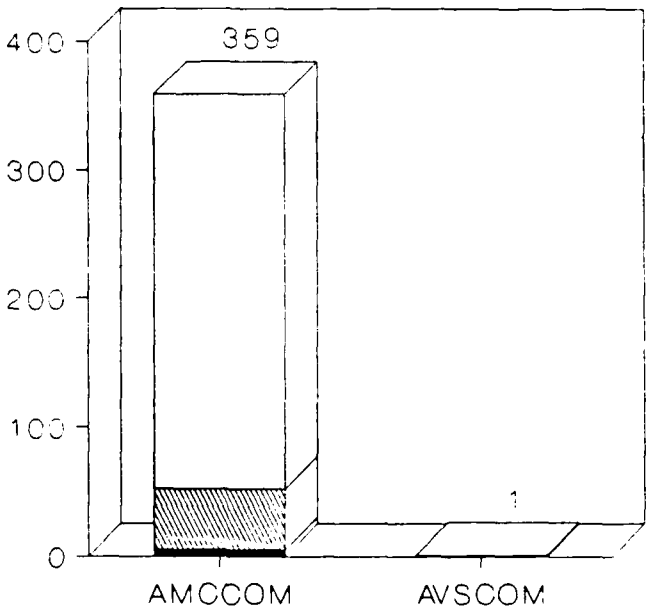

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20 YRS & OVER | 316 | 20 | 26 | 40 | 12 | 22 | 1 | 39 |
| 10-19 YRS | 234 | 24 | 31 | 19 | 11 | 33 | 3 | 11 |
| 0-9 YRS | 182 | 12 | 50 | 13 | 5 | 30 | 8 | 13 |

0-9 YRS  10-19 YRS
20 YRS & OVER

AS OF 30 AUG 1989

AMCCOM has in their charge the majority of this category, managing 63 percent of the active heat treat machine inventory. Throughout this section, AMCCOM has been seen to manage the preponderance of AMC equipment. This is consistent with the fact that AMCCOM manages five Government-Owned-Government-Operated (GOGO) plants - two ammunition plants/activities and three arsenals - and 25 Government-Owned-Contractor-Operated (GOCO) ammunition plants. Nearly all of the associated plant equipment is owned by the Army rather than a contractor.

# MAJOR SUBORDINATE COMMANDS
## INACTIVE HEAT TREAT EQUIPMENT




| | AMCCOM | AVSCOM |
|---|---|---|
| 20 YRS & OVER | 307 | 1 |
| 10-19 YRS | 47 | 0 |
| 0-9 YRS | 5 | 0 |

0-9 YRS  10-19 YRS
20 YRS & OVER

AS OF 30 AUG 1989

In the graph above, 85 percent of the inactive heat treat equipment is advanced in years, having been manufactured prior to 1970.

## SECTION IV

## NUMERICAL CONTROL (NC)

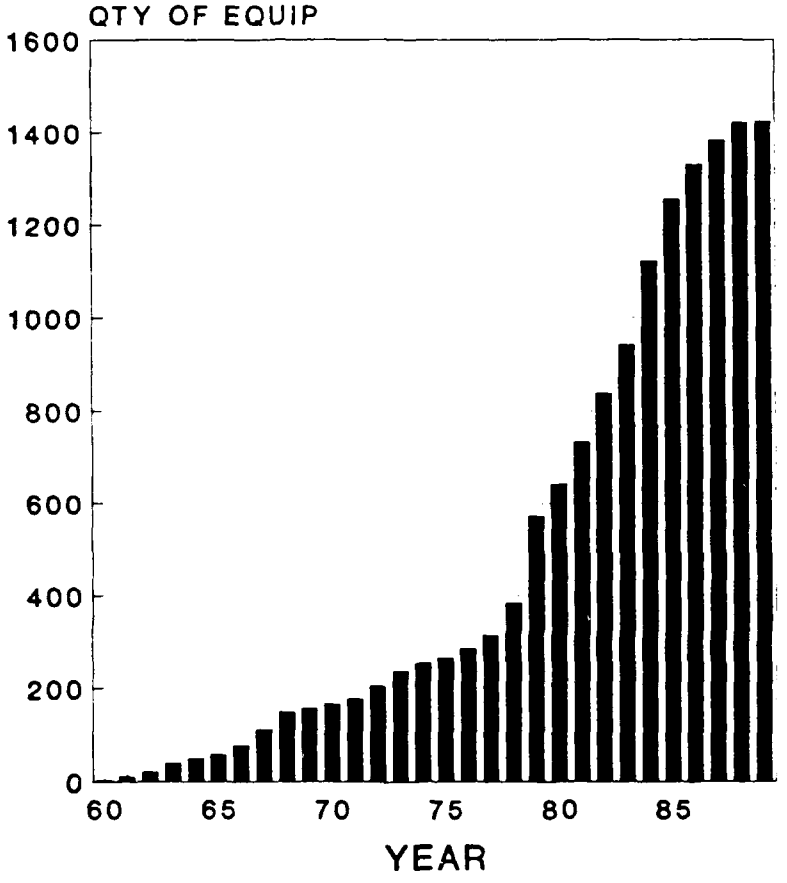
The numerically controlled equipment owned by the Army has been divided into seven major classes as shown on the chart below. These classes are lathes, grinders, bores, drills, mills, mechanical test and measuring machines, and machining centers. All other equipment falls into classes with less than twenty five items of NC equipment and has been classified below under the category called other. The other category also includes ammunition peculiar equipment and one of a kind special purpose NC machines.

The chart below breaks each class into two categories, active and inactive equipment. Inactive equipment accounts for 4.4 percent of the total number of NC machines, a relatively small percentage compared to 27 percent inactive non-NC metalworking equipment. This can be attributed to the fact that organizations wish to take advantage of the improved operating characteristics of NC machines in addition to the fact that the NC machines in the inventory are younger on average than the non-NC machines. The average age for NC machines is 10 years while the average age for non-NC machines is 26 years of age. This is expected due to the fact that NC machines were not introduced into the manufacturing environment to any significant degree until the 1970's.

| EQUIPMENT TYPE | TOTAL | ACTIVE | INACTIVE |
|---|---|---|---|
| BORES | 227 | 214 | 13 |
| DRILLS | 30 | 22 | 8 |
| GRINDERS | 46 | 46 | 0 |
| LATHES | 554 | 543 | 11 |
| MACHINING CTRS | 250 | 230 | 20 |
| MECH TEST/MEAS | 34 | 33 | 1 |
| MILLS | 163 | 151 | 12 |
| OTHER | 162 | 162 | 0 |
| TOTAL | 1466 | 1401 | 65 |

The numerical control inventory of AMC consists of 1,466 items of IPE with an acquisition cost of $424 million and a replacement cost of $704 million.

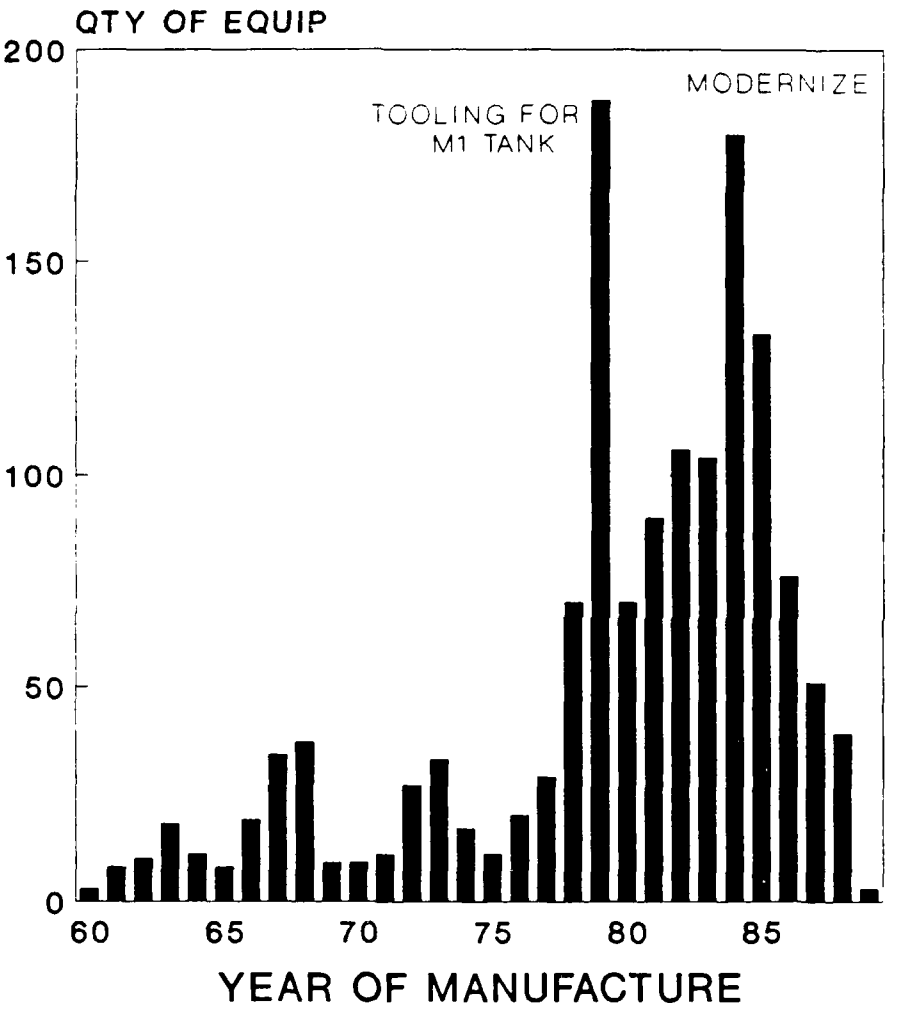
# INVENTORY TRENDS OF NUMERICAL CONTROL EQUIPMENT




AS OF 30 AUG 1989

The number of numerically controlled machine tools installed in metalworking plants in private industry in America has more than doubled in the last six years according to the 14th American Machinist Inventory. This is an increase of approximately 13 percent per year. The Army inventory of NC equipment was increasing at approximately the same rate from 1983 through 1985. In 1986, however, the rate of increase as shown on the graph above appears to drop. The figures on equipment purchased from 1986 to the present can be misleading due to the factors discussed on pages 4 and 5.

# AGE DISTRIBUTION OF NC EQUIPMENT




AS OF 30 AUG 1989

The average age for NC machines is 10 years. The above chart indicates the quantity of NC machines purchased in a particular year. The purchase of machine tools to gear up for the production of the M1 tank contributed to the spike in 1979. The spike in 1984 was caused by the purchase of machine tools for modernization of several ammunition metal parts facilities. The figures for the years 1986 to 1989 do not fully reflect the actual situation for reasons previously discussed.

## SECTION V

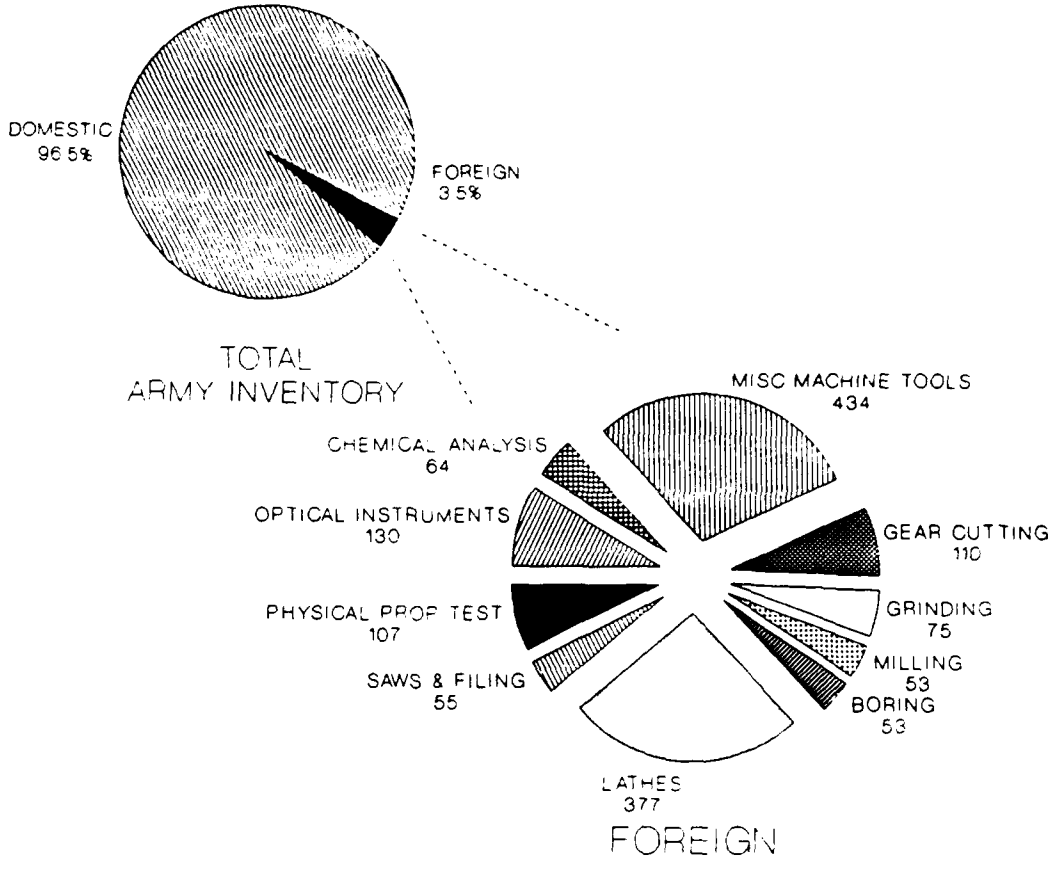
## FOREIGN MACHINE TOOLS IN THE ARMY INVENTORY

This section presents information on quantities and sources of the foreign equipment in the Army inventory. To obtain this information, the Commercial and Government Entity (CAGE) Code is used as a reference. This is a code assigned to a contractor or manufacturer by the Defense Logistics Services Center (DLSC). For some North Atlantic Treaty (NATO) Countries, the code is assigned by a member of NATO. When a new machine is purchased by the Army, the CAGE code for the contractor or manufacturer is loaded with the machine information into the DIPEC database. It is this code that has been used in the determination of the country of origin for the machine tools in this study. Parts for a specific machine may be manufactured in many locations around the world, only to be assembled in another country. The analysis in this chapter attempts only to give a broad overview of the origin and types of foreign equipment in the Army inventory.

There has been increasing concern in the Government over the past several years regarding the supportability of foreign purchased machine tools in our industrial base, should a national emergency occur. In fact, there is often difficulty obtaining replacement parts for foreign machine tools in peacetime. The U.S. has fallen into fifth place in machine tool production behind Japan, West Germany, the Soviet Union, and Italy, according to the 16 Oct 89 Industry Week. The number of foreign machine tools in the mobilization base will likely increase in the future and compound this concern. Congress has addressed this concern in the passage of the 1987-1989 Appropriation and 1989 Authorization Acts. Federal Acquisition Regulation (FAR) 225.70 implements the provisions of the legislation. It restricts the purchase of certain classes of machine tools to U.S. or Canadian manufacturing origin when the machine tool is being acquired for use in any Government-owned facility or property under control of the DoD.

The FAR defines foreign source machines to be those machine tools where the costs of its U.S. components are less than or equal to 50% of the cost of all components. Although this definition seems straightforward, in practice, it is not always clear what is and what is not foreign. There have been a number of instances where the FAR clause was misinterpreted as applying to the contract price, rather than the price of all components. In fact, transportation, assembly, marketing and other similar costs must be excluded.

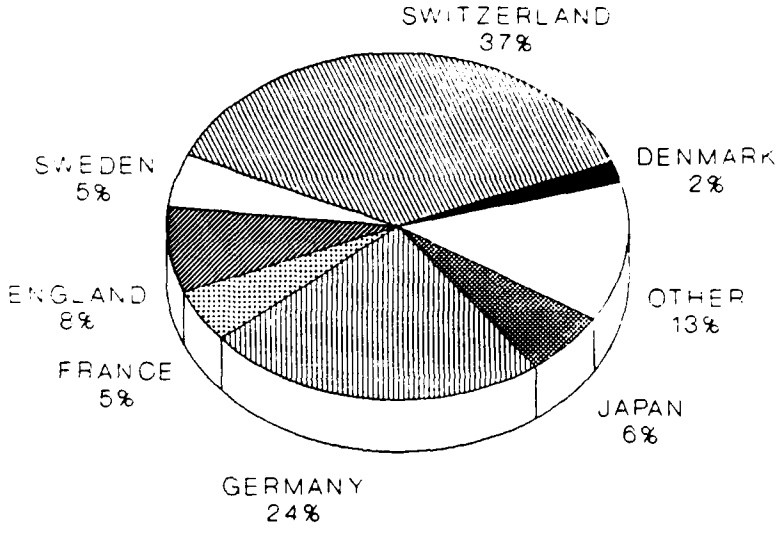
# TYPES OF FOREIGN MACHINE TOOLS IN THE ARMY INVENTORY




AS OF 30 AUG 1989

The pie chart on the upper left, shows the vast majority of the 41,223 machine tools in the Army inventory were purchased from domestic manufacturers. The pie chart on the right provides a quantity breakout of the 3.5%, or 1,458 pieces, of foreign equipment in the Army inventory. The largest single class of machine tools purchased from foreign manufacturers is the lathe. The miscellaneous machine tool category is made up of many diverse classifications of IPE to include: drilling and tapping, welding, punching, presses, and special ammunition ordnance type equipment. Machines were classified in the miscellaneous category when their individual IPE classification did not exceed fifty in number.

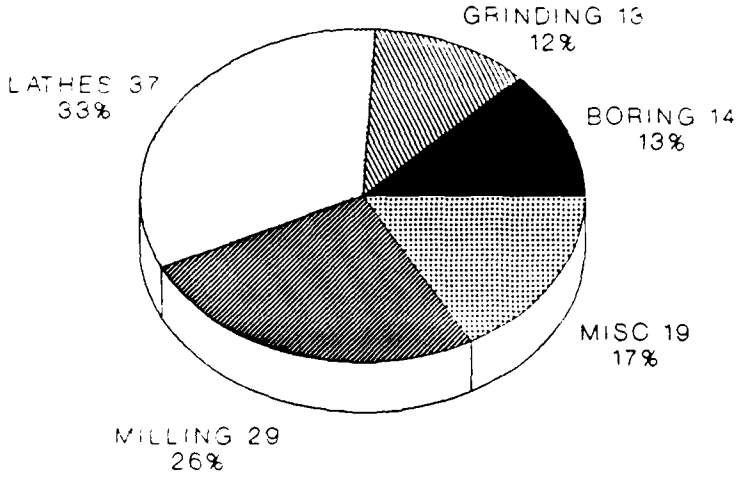
# FOREIGN SOURCES OF MACHINE TOOLS IN THE ARMY INVENTORY




AS OF 30 AUG 1989

From what countries did we purchase the 1,458 foreign machine tools? Switzerland has manufactured the greatest share of our foreign machine tool inventory. They sold us many of our foreign machining centers, boring machines, gear cutting and finishing machines, and lathes. Germany also had a substantial share of our foreign machine tool market, selling us drilling and tapping equipment, grinding machines, milling, welding, and optical equipment. Countries which fall into the "other" category in the chart above include Belgium, Italy, China, and Austria.

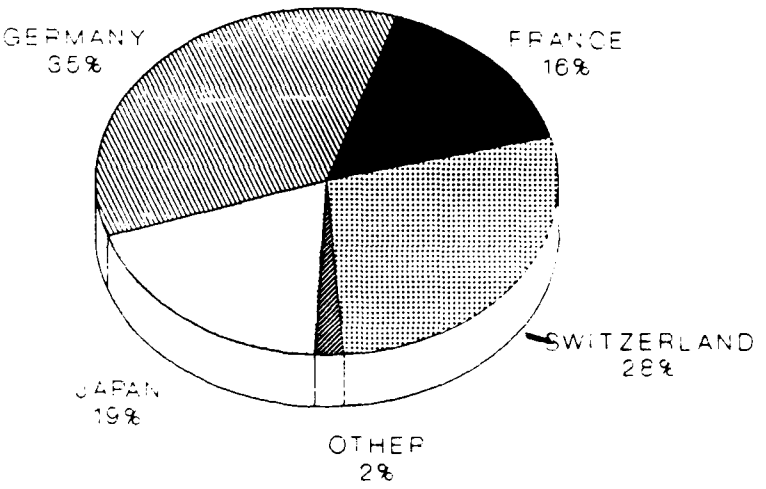
# TYPES OF FOREIGN NC MACHINE TOOLS IN THE ARMY INVENTORY




AS OF 30 AUG 1989

Of the 1,466 items of Numerical Control Industrial Plant Equipment (IPE) mentioned on page 30, 112 of them are from foreign manufacturers or approximately 8 percent of the Army NC inventory. This is higher than the 3.5 percent foreign inventory of all Army IPE. More than half the foreign NC machines are lathes and milling machines.

# FOREIGN SOURCES OF NC MACHINE TOOLS IN THE ARMY INVENTORY




AS OF 30 AUG 1989

The sources for the 112 items of foreign origin NC equipment in the Army inventory are shown above. Germany has manufactured the largest share of our foreign NC inventory relative to other countries. Japan and Switzerland manufactured nearly all the NC boring equipment. Germany, Japan, and France manufactured nearly all the NC lathes. Germany and Switzerland manufactured nearly all the NC milling machines in the Army inventory.

# SECTION VI

# REPLACEMENT DATA

## REPLACEMENT COSTS

Replacement factors for metalworking, metalcutting, special tooling, and special test equipment are provided in Appendix C. They are based on an average price index provided by the U.S. Department of Labor, Bureau of Labor Statistics.

## LEAD TIMES

Lead time is the period between which the order is received by the manufacturer and the machine is received by the purchaser. Lead time is a built in characteristic of the machine tool industry and is dependent on many factors which include the size and complexity of the machine, the individual manufacturer's characteristics, and the business cycle. In slack periods, machines will be delivered relatively quickly. However, in prosperous times, a backlog can arise which can double or triple lead time.

These factors combined make lead time estimation very difficult. Further, a constantly changing market will invalidate lead time estimates quickly. However, metalcutting and metalforming machines will generally have a longer lead time under any conditions than welding and testing/measuring machines, which will generally have the shortest lead time. Heat treat machines will usually fall between. According to the Office of General Industrial Machinery, Capital Goods, and Industrial Construction of the U.S. Department of Commerce, the current average production lead time to delivery is 9 to 12 months for small to medium size general purpose machine tools and 12 to 18 months for the larger general purpose machine tools. More complex machines such as machining centers have a lead time of approximately 12 to 18 months.

In addition to the aforementioned considerations, the Government must let the contract. The administrative lead time associated with this process can run from a minimum of 6 months up to 12 months. This means the cumulative lead time to let a contract and wait for the manufacture of the machine could be up to 30 months.

## APPENDIX A

## CONDITION CODES

| CODE | BRIEF DESCRIPTION | EXPANDED DESCRIPTION |
|---|---|---|
| E1 | Used-Reconditioned-Excellent | Used property, but repaired or renovated and in excellent condition |
| O2 | Used-Usable Without Repairs-Good | Used property, but in still in good condition with considerable use left before any important repairs would be required |
| O3 | Used-Useable Without Repairs-Fair | Used property which is still in fair condition and usable without repairs; however, somewhat deteriorated, with some parts (or portion) worn or should be replaced. |
| O4 | Used-Useable Without Repairs-Poor | Used property which is still useable without repairs, but in poor condition and undependable or uneconomical in use. Parts badly worn or deteriorated. |
| R1 | Used-Repairs Required-Excellent | Used property, still in excellent condition, but minor repairs required (repairs would not cost more than 10% of acquisition cost). |
| R2 | Used-Repairs Required-Good | Used property, in good condition but considerable repairs required. Estimated cost of repairs would be from 11% to 25% of acquisition cost. |
| R3 | Used-Repairs Required-Fair | Used property, in fair condition but extensive repairs required. Estimated repair costs would be from 26% to 40% of acquisition cost. |
| R4 | Used-Repairs Required-Poor | Used property, in poor condition and requiring major repairs. Badly worn, and would still be in doubtful condition of dependability and uneconomical to use if repaired. Estimated repair costs from 41% to 65% of acquisition cost. |

## APPENDIX B

Federal Supply Classes (FSCs) Included in the Five Major Subclassifications of Industrial Plant Equipment (IPE)

### METALCUTTING

| FSC | |
|---|---|
| 3405 | Saw and Filing Machines |
| 3408 | Machining Centers and Way Type Machines |
| 3410 | Electrical and Ultrasonic Erosion Machines |
| 3411 | Boring Machines |
| 3412 | Broaching Machines |
| 3413 | Drilling and Tapping Machines |
| 3414 | Gear Cutting and Finishing Machines |
| 3415 | Grinding Machines |
| 3416 | Lathes |
| 3417 | Milling Machines |
| 3418 | Planers and Shapers |
| 3419 | Miscellaneous Machine Tools |

### WELDING

| | |
|---|---|
| 3431 | Electric Arc Welding Equipment |
| 3432 | Electric Resistance Welding Equipment |
| 3433 | Gas Welding, Heat Cutting and Metalizing Equipment |
| 3436 | Welding Positioners and Manipulators |
| 3438 | Miscellaneous Welding Equipment |

### METAL FORMING

| | |
|---|---|
| 3422 | Rolling Mills and Drawing Machines |
| 3441 | Bending and Forming Machines |
| 3442 | Hydraulic and Pneumatic Presses, Power Driven |
| 3443 | Mechanical Power Presses |
| 3445 | Punching and Shearing Machines |
| 3446 | Forging Machinery and Hammers |
| 3447 | Wire and Metal Ribbon Forming Machines |
| 3448 | Riveting Machines |

### HEAT TREAT AND FURNACES

| | |
|---|---|
| 3424 | Metal Heat Treating and Nonthermal Treating Equipment |
| 4430 | Industrial Furnaces, Kilns, Lehrs, and Ovens |

### MECHANICAL TESTING AND MEASURING DEVICES

| | |
|---|---|
| 6635 | Physical Properties Testing Equipment |

## APPENDIX C

### PRODUCTION EQUIPMENT REPLACEMENT FACTORS
### As of December 1989

| YEAR OF ACQUISITION | METALWORKING MACHINERY EQUIPMENT* | METAL CUTTING & METAL FORMING MACHINE TOOLS** | SPECIAL TOOLING *** | SPECIAL TEST EQUIPMENT**** |
|---|---|---|---|---|
| 1989 | 1.00 | 1.00 | 1.00 | 1.00 |
| 1988 | 1.04 | 1.05 | 1.03 | 1.03 |
| 1987 | 1.07 | 1.08 | 1.04 | 1.05 |
| 1986 | 1.09 | 1.11 | 1.06 | 1.06 |
| 1985 | 1.11 | 1.13 | 1.07 | 1.08 |
| 1984 | 1.14 | 1.15 | 1.09 | 1.10 |
| 82/83 | 1.17 | 1.19 | 1.13 | 1.17 |
| 80/81 | 1.32 | 1.35 | 1.26 | 1.34 |
| 78/79 | 1.66 | 1.76 | 1.59 | 1.56 |
| 76/77 | 1.98 | 2.22 | 1.92 | 1.74 |
| 74/75 | 2.38 | 2.74 | 2.29 | 2.04 |
| 72/73 | 3.09 | 3.68 | 2.97 | 2.39 |
| 70/71 | 3.27 | 3.97 | 3.15 | 2.49 |
| 68/69 | 3.58 | 4.42 | 3.45 | 2.67 |
| 66/67 | 3.88 | 4.77 | 3.73 | 2.83 |
| 64/65 | 4.19 | 5.37 | 4.04 | N/A |
| 60/63 | 4.39 | 5.84 | 4.23 | N/A |
| 57/59 | 4.69 | 6.16 | 4.51 | N/A |
| 55/56 | 5.32 | 7.06 | 5.13 | N/A |
| 52/54 | 5.97 | 8.00 | 5.75 | N/A |
| 49/51 | 6.75 | 9.66 | 6.50 | N/A |
| 46/48 | 7.99 | 11.96 | 7.69 | N/A |
| 41/45 | 9.53 | N/A | N/A | N/A |
| 39/40 | 10.02 | N/A | N/A | N/A |
| 38-PRIOR | 11.70 | N/A | N/A | N/A |

* The Metalworking Machinery and Equipment column represents machine tools, power driven hand tools, welding machines and equipment, industrial process furnaces and ovens, cutting tools and accessories, and abrasive products.

** Metal Cutting and Metal Forming Machine Tools are subgroups of the Metalworking Machinery and equipment group. They include conventionally and numerically controlled machine tools and parts for the same.

*** Special Tooling as used in this column means jigs, dies, fixtures, molds, patterns, taps, gauges, and other equipment which are of such a specialized nature that without substantial modification or alteration their use is limited to the development or production of particular supplies or performance of particular services (FAR 45.101).

**** The Special Test Equipment column applies to single or multi-function test equipment, measuring and controlling devices, physical properties testing and optical and analytical instruments engineered, designed, fabricated or modified to accomplish special purpose testing. It consists of items or assemblies of equipment including standard or general purpose items or components that are interconnected and interdependent so as to become a new functional entity for special testing purposes (FAR 45.101).

**NOTES:**

a. Acquisition cost times replacement factor equals replacement value.

b. Because of the continuous technological improvement in machine tools and the increasing number of "custom built" machines, reliable wholesale price indexes (which are intended to measure price changes not influenced by changes in quality, product mix, etc.) are difficult to develop. Recognizing this fact, the data should be used with caution. If available, new replacement prices should be used.

Changes in calculating the Finished Goods Price Index were published by the U.S. Department of Labor, Bureau of Labor Statistics in January 1988 which affected the calculations for developing the replacement factors. IEA developed new replacement factors based upon the indexes provided and previous available data. Replacement factors are based on an average price index for December 1989.